

WHAT IS CLAIMED IS:

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1. A method of preparing a cerium oxide particle composition comprising preparing a solution consisting essentially of a cerium oxide precursor, converting the cerium oxide precursor solution into an aerosol having droplets with a diameter of about 100 μm or less, passing the aerosol through a high temperature reaction zone so that the cerium oxide precursor is converted to aggregates consisting essentially of approximately spherical primary particles of cerium oxide, and recovering the resulting aggregates as a cerium oxide particle composition.
 2. The method of claim 1, wherein the high temperature reaction zone is a flame.
 3. The method of claim 2, wherein the aggregates are a mixture of aciniform aggregates and cenospherical aggregates.
 4. The method of claim 3, wherein about 90% or more (by weight) of the aggregates are cenospherical aggregates.
 5. The method of claim 4, wherein about 95% or more (by weight) of the aggregates are cenospherical aggregates.
 6. The method of claim 5, wherein about 98% or more (by weight) of the aggregates are cenospherical aggregates.
 7. The method of claim 1, wherein the solution of a cerium oxide precursor is an aqueous solution.
 8. The method of claim 7, wherein the aqueous solution comprises alcohol.
 9. The method of claim 8, wherein the alcohol is methanol or ethanol.
 10. The method of claim 7, wherein the solution of a cerium oxide precursor is acidic.

11. The method of claim 1, wherein the solution of a cerium oxide precursor is about 5 wt.% or more of the cerium oxide precursor.

5 12. The method of claim 11, wherein the solution of a cerium oxide precursor is about 10 wt.% or more of the cerium oxide precursor.

13. The method of claim 1, wherein the droplets have a diameter of about 10-100 μm .

10 14. The method of claim 1, wherein the high temperature reaction zone has a temperature of about 700-2000 K.

15 15. The method of claim 14, wherein the high temperature reaction zone has a temperature of about 700-1100 K.

16. The method of claim 1, wherein the cerium oxide precursor is selected from the group consisting of cerium acetate, cerium acetylacetonate, cerium chloride, cerium nitrate, cerium oxalate, and cerium perchlorate.

20 17. The method of claim 16, wherein the cerium oxide precursor is cerium acetate.

25 18. The method of claim 16, wherein the cerium oxide precursor is cerium acetylacetonate.

19. The method of claim 1, wherein the primary particles are of crystalline cerium oxide.

30 20. The method of claim 19, wherein the crystalline cerium oxide comprises cubic phase crystalline cerium oxide.

21. The method of claims 1, wherein the primary particles have an average diameter (by number) of about 30 nm or less.

35 22. The method of claim 21, wherein the primary particles have an average diameter (by number) of about 20 nm or less.

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23. The method of claim 22, wherein the primary particles have an average diameter (by number) of about 10 nm or less.

24. The method of claim 1, wherein the aggregates have a density of about 6 g/cm³ or more.

25. The method of claim 24, wherein the aggregates have a density of about 6-7 g/cm³.

26. The method of claim 3, wherein the cenospherical aggregates have an average particle diameter (by weight) of about 1-20 μm.

27. The method of claim 26, wherein the cenospherical aggregates have an average particle diameter (by weight) of about 5-10 μm.

28. The method of claims 3, wherein the aciniform aggregates have an average particle diameter (by number) of about 500 nm or less.

29. The method of claim 28, wherein the aciniform aggregates have an average diameter (by number) of about 200 nm or less.

30. The method of claim 29, wherein the aciniform aggregates have an average diameter (by number) of about 100 nm or less.

31. The method of claim 1, wherein the aggregates have a surface area of about 50 m²/g or more.

32. The method of claim 31, wherein the aggregates have has a surface area of about 70 m²/g or more.

33. The method of claim 1, wherein the aggregates are not calcined.

34. A cerium oxide particulate composition comprising aggregates consisting essentially of approximately spherical primary particles of cerium oxide, wherein at least some of the aggregates are cenospherical aggregates.

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35. The composition of claim 34, wherein the remainder of the aggregates are aciniform aggregates.

36. The composition of claim 35, wherein about 90% or more (by weight) of the aggregates are cenospherical aggregates.

37. The composition of claim 36, wherein about 95% or more (by weight) of the aggregates are cenospherical aggregates.

38. The composition of claim 37, wherein about 98% or more (by weight) of the aggregates are cenospherical aggregates.

39. The composition of claim 34, wherein the primary particles have an average diameter (by number) of about 30 nm or less.

40. The composition of claim 39, wherein the primary particles have an average diameter (by number) of about 20 nm or less.

41. The composition of claim 40, wherein the primary particles have an average diameter (by number) of about 10 nm or less.

42. The composition of claim 34, wherein the aggregates have a density of about 6 g/cm³ or more.

43. The composition of claim 42, wherein the aggregates have a density of about 6-7 g/cm³.

44. The composition of claim 34, wherein the cenospherical aggregates have an average diameter (by weight) of about 1-20 μ m.

45. The composition of claim 44, wherein the cenospherical aggregates have an average diameter (by weight) of about 5-10 μ m.

46. The composition of claim 35, wherein the aciniform aggregates have an average diameter (by number) of about 500 nm or less.

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47. The composition of claim 46, wherein the aciniform aggregates have an average diameter (by number) of about 200 nm or less.

5 48. The composition of claim 47, wherein the aciniform aggregates have an average diameter (by number) of about 100 nm or less.

49. The composition of claim 34, wherein the aggregates have a surface area of about 50 m²/g or more.

10 50. The composition of claim 49, wherein the aggregates have a surface area of about 70 m²/g or more.

15 51. The composition of claim 1, wherein the primary particles have a crystallite size of about 1-30 nm.

52. The composition of claim 51, wherein the primary particles have a crystallite size of about 5-15 nm.

20 53. The method of claim 9, wherein the solution of a cerium oxide precursor is acidic.

54. The method of claim 10, wherein the solution of a cerium oxide precursor contains nitric acid.

25 55. The method of claim 53, wherein the solution of a cerium oxide precursor contains nitric acid.

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